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THE FINGER LAKES OF NEW YORK.

BY

ALBERT P. BRIGHAM.

Lakes belong clearly within the domain of what is sometimes called Geographical Geology. Their geographical interest is not small. Their variety in size, from the smallest natural ponds up to inland seas, their diversity in shape, depth and altitude, and their great numbers, are facts which strike the attention and suggest inquiry. From an economic point of view they afford abundant materials for consideration as bearers of traffic, as regulators of floods, as centres of resort, and for their effects upon climate. Studied geologically, lakes open up an important body of facts. Primeval continents could not have progressed far in their growth before lake making conditions began to appear. Viewed individually, lakes are affairs of short life. Geological forces are always making lake basins, and such basins are constantly being destroyed by filling with sediment, or by the cutting down of their rims; or, the basin may remain, while the lake is destroyed by desiccation. On most competent authority,* the numerous lakes of the Scottish Highlands are but a fraction of what have formerly existed. The variety of forces whose action aids in bringing lakes into being, has suggested the most convenient classification of lakes, that is, according to their origin.† Thus we have a relatively small group of lakes of volcanic origin, occupying old craters or valleys obstructed by lava. More important is the group of orographic lakes, or those due to deformation of the earth's crust. Here belong the lakes of the Great Basin, and, according to some, our Great Lakes, and Champlain. In limestone countries, solution lakes are not uncommon, and this agency has been operative in enlarging many basins, due primarily to other agencies. Landslip lakes have been noticed by Lyell,‡ and Gilbert records the formation of small lakes behind landslip terraces.§ River and shore lagoons must be named in any full classification, while glaciation, in one way or another, is responsible for the existence of most lakes. Here we have the ice-dam or temporary type, as Agassiz and Iroquois, the kettle-hole group, which is often made to include what Geikie calls "Lakes of the Plains," ‖ and which he defines as lakes that "lie in hollows of the covering of detritus left on the surface of country when the ice-sheets and icebergs retreated." Thus they differ from the kettle-hole ponds, which are thought to have frequently originated by the sliding of debris from stranded bergs or ice masses isolated by retreat of the main sheet. Other glacial lakes are due to morainic dams in valleys, and yet others, beyond dispute, as it seems to me, are in whole or in part, rock basins, due to glacial excavation. The lakes by morainic dams and by excavation introduce us to those lakes of New York, which will have chief attention in this paper.

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* Geikie, Scenery of Scotland, p. 241.

† See "Classification of Lake Basins" by Prof. W. M. Davis, Proc. Boston Soc. Nat. Hist., Vol. XXI., 1882, p. 321. The several kinds are ranged under the general heads, "Constructive," "Destructive," "Obstructive."

‡ Principles of Geology, II., p. 129, 11th ed.

§ Lake Bonneville, pp. 83, 84.

‖ Scenery of Scotland, p. 227.

For convenience, we may regard the lakes of the State as comprised in three groups: first, the Great Lakes, Erie and Ontario, to which we may add Champlain. Second, the Adirondack Lakes. Disposed, at first sight, in extreme disorder, any map will, on scrutiny, disclose a measure of system, a prevailing northeast by southwest range, suggesting an orographic origin of the mountain valleys in which they lie, though glacial forces have doubtless mainly originated their basins. These lakes offer some sharp contrasts with those later to be considered, as in their irregularity of form, the boldness of the surrounding topography, the greater amount of lake filling, and their relatively great altitude, ranging from 1500 to more than 4000 feet above the sea level.

We shall now undertake some study of the third great group of our larger lakes, the north and south lakes lying between the Ontario-Mohawk depression and the southern tier of counties. We may regard the region as a unit or single plateau, extending from the Catskill Mountains to the Genesee River, a plateau whose summits are about 2000 feet above the sea level, and whose general surface is much of it above 1000 feet. Or we may, better for our present purpose, consider the tract as composed of two inclines, one sloping northward to Lake Ontario and the Mohawk River, and the other southward, bearing the head-waters of the Chemung-Susquehanna. Upon both faces of this east and west ridge or plateau, and continuing across the divide, is found that remarkable series of valleys, whose history is essentially the history of the lakes in question. These valleys, owing to their number and uniformity, have attracted attention ever since the topography of the Empire State began to be studied. Vanuxem, in his volume of the final report on the geology of New York, takes up the problem, and well illustrates the struggle which good and trained observers had, fifty years ago, in their effort to reduce refractory facts to order, without the help of ice.*

If we begin at the east and go to the western limit of the State, we may call the lakes the Otsego-Chautauqua series, or we may limit our view to those lying between Otisco and the Genesee River, and then we shall have the Otisco-Conesus group, or, as commonly known, the Finger Lakes of New York.

Concerning these latter the principal topographic facts are as follows. They lie on the northern slope of the plateau, or in the hydrographic basin of Lake Ontario. From Otisco to Canandaigua they have a concentric trend northward, and to this series Onondaga and Oneida may be added, whatever may be said of the genesis of the latter lakes. All these have their outlet through the Seneca and Oswego rivers, while Honeoye, Canadice, Hemlock and Conesus trend slightly west of north and send their waters to the Genesee. It is at least suggestive that the little Silver Lake west of the Genesee trends north-eastward, and likewise finds an outlet to the same river. The recency of these outlets is perfectly evident, whether flowing sluggishly out on the surface of the drift, as in the case of Cayuga, or having cut shallow cañons for part of their course, as in the case of more elevated lakes like Silver or Skaneateles. In length the lakes vary from three or four miles, as Silver and Canadice, to about fifteen in the case of Canandaigua and Skaneateles, and to above thirty for Seneca and Cayuga. The latter two show a maximum width of over three miles. The greatest depth of Seneca is 618 feet, and of Cayuga 435 feet. The deepest parts of Keuka measure about 175 feet, of Skaneateles, 275 feet, and of Canandaigua, 240 feet. As to altitude, it increases almost uniformly as the size of the lakes decreases, from Cayuga at 378, to Canadice at 1099.

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* See Geology of Third District, pp. 235–238 where, at the close of his discussion, Vanuxem says: "Patient investigation, in time, if true, will harmonize their results; for truths only apparently conflict with each other, the real conflict being solely in the minds of those occupied with them."

Closely related to the lake basins are the intervening ridges, which rise from an almost undifferentiated plain at the north to bold swells at the south, having, from a distance, an extremely uniform appearance, and rolling down to the surface of the lakes like arcs of great cylinders. Sometimes the tops and upper flanks of these ridges are diversified by long, gentle, drumloidal swells, telling unerringly the story of glacial moulding.

Cutting down across the lower flanks are innumerable ravines, entering the lake basins at right angles, and lining off the open farm-lands with parallel strips of forest. The map published by the engineering department of Cornell University records 223 of these lateral streams entering Cayuga lake, of which but 13 enter the northern third, a most instructive fact in tracing the topographic development of the region. South of the lake region, about coincident with the line of hill summits and the water parting of the valleys, is the terminal moraine of the second glaciation, another important fact as regards the history of the excavations. The lake belt may be said to join the flat, milder and richer northern regions of western New York, with the high, cold and poorer uplands of many of its southern counties.

All the larger lakes, except Keuka, have their northern terminus in or near the Helderberg zone of rocks, while their southern ends are commonly in the Upper Devonian sandstones. Much of the soil at the north, therefore, is debris of the Niagara, Salina and Helderberg rocks, which, compared with Hamilton and Portage soils and the increase in altitude, readily explain the economic diversity of the northern and southern counties. About the lakes and upon their ascending hillsides the lakes act as reservoirs of heat to delay the autumn frosts, and so combine with conditions of soil to favor the fruit industries of Keuka and other lakes. The scenery of these lakes demands at least a passing notice, and would amply reward the attention of the student or the tourist. Never bold, save in some of the cañons like Watkins, it yet should not be overlooked or despised because it is so accessible, and surely not by those who share the writer's enthusiasm for the varied resources and beauty of the Empire State.

We shall come now to some considerations bearing on the genesis and history of these basins. Some of the facts to be accounted for are as follows :—What is the origin of the north and south valleys? Why do the Finger Lake valleys have a concentric trend? What has transformed parts of the valleys into depressions capable of holding water? Why do they lie in an east and west series, in rocks of the same horizons and terminating northward on about the same parallel? Why do they occur in such numbers in western New York, and have a limited development farther east? Why do the lakes narrow and at the same time deepen toward their southern ends? The last consideration is worthy of further note before we proceed. The average of a line of cross soundings one mile from the north end of Skaneateles Lake is 34 feet, one mile from the south end is 106 feet. For the north end of Canandaigua Lake we have 17 feet, for the south end 164 feet. Similar averages for the larger lakes four miles from either end give for Cayuga 11 feet at the north and 275 feet at the south; for Seneca 149 feet at the north and 400 feet at the south. The meaning of these facts will be discussed further on.

We naturally divide the history into three chapters and inquire how much of the physical evolution of this region is pre-glacial, how much is glacial and interglacial, and what features are post-glacial.

The pre-glacial development of topography carries us so far back that we are compelled to speculate rather than arrive at conclusions. Granted the initiation of the Laurentian depression, probably by orographic movement, and we have the beginnings of an erosion which would in time strip off the upper Paleozoic beds, consume and bevel off their northern outcrops, and give us an approach to the incline which slopes off into Lake Ontario. Just where this long erosion left the line of water partings we cannot tell. And how far the cols were developed which now unite the valleys across the ridge, is a question which students will answer according to their belief or non-belief in the digging power of glaciers. My own impression is that the opposing Susquehanna and Laurentian stream systems had worked back upon each other until their head waters were thoroughly interlocked, and had in many cases merged into each other, forming cols which should afterward be vigorously rimmed out by ice streams.

If we inquire as to the form of these pre-glacial valleys, we naturally refer to a non-glaciated area for light upon the question. Here we learn that when a stream has nearly or quite reached its base level, it begins to wander from side to side, giving rise to flat-bottomed valleys, often bordered by lines of cliff, formed by under cutting and removal of the talus.*

The Finger Lakes in cross section often give evidence of such old flat-bottomed valleys, whose profiles have not been destroyed even by important glacial excavation. Soundings of 150 to 300 feet are not very uncommon within 500 feet of the shore of the larger lakes, offering a natural extension of the sharply descending slopes above the water's edge, which are characteristic of the southern half of the lakes. I believe that Seneca, Cayuga, and the Genesee mark such deep, broad-channelled, pre-glacial trenches. Thus the present altitude of Cayuga Lake is 378 feet. The level of the old valley was probably lower, owing to drift filling at the north, though this might be offset by glacial erosion. The altitude of Seneca is 441 feet, while the old valley was probably quite as deeply cut as that of Cayuga. Compare the Genesee, whose alluvial bottoms are but 595 feet above tide at Mt. Morris, which is fully forty miles from Lake Ontario. The remaining and important question as to pre-glacial topography relates to the direction of the streams, which many have held to have discharged southward into the Susquehanna system. I believe the facts to be almost wholly opposed to this view, and shall give my reasons in discussing the glacial history. I am, however, prepared to believe that the locus of the watershed has been slightly shifted southwards. It is natural to think that a heavy mass of ice would grind powerfully on the stoss side (if I may use the word in this way) of a ridge crossing its track, and push the materials over, causing the crest to migrate in the direction of the flow.

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* See "Driftless Area of the Upper Mississippi Valley," Chamberlin and Salisbury, 6th Annual Report U. S. Geol. Surv., pp. 225–228.

We turn to the glacial chapter in this history. I ask you to keep in mind the conditions which a long pre-glacial development had wrought—a northward slope as at present, creased by important valleys, bearing streams northward into the pre-glacial representative of Lake Ontario, be it river or lake. Remember that we have a country free from drift, without foreign bowlders, with soils mainly of the class known as residual, or products of rocks decaying in place.

What changes did the ice work upon such a surface? To anticipate, we may say that the ice brought it nearly to its present form, for the aggregate of post-glacial modification, though highly interesting, is not extensive. My conviction as to the amount of glacial change is, that it was extensive, but not revolutionary. Such change, it is well understood, is capable of discrimination into two elements, sculpture and modelling, carving of consolidated rock, and moulding of loose materials. The Finger Lake country illustrates both phases of glacial work to perfection. The obliteration of the valleys northward, and the gathering up of the several outflowing streams into the sluggish Seneca River, would of itself be sufficient evidence of a glacial filling which had erased the features of pre-glacial drainage, while the smoothed contours and drumlin swells of the ridges which lie between the lakes prove with equal certainty that ice is something more than a soft brush, gently grazing the face of a country.

South of the lakes and about coincident with the line of water partings, runs the moraine of the Second Glacial Epoch. The relative position of this moraine and of the lakes appears to be an important fact, as I shall show, in the genesis of the basins. That the moraine deeply clogged the valleys of streams which once flowed southward, and created basins of the morainic dam type, is a theory to which I think the following facts are fatal. First:—The general and pronounced slope of the country toward the north. I can form no conception of a region whose general slope is in one direction, and whose main streams are in another. Base level is first attained about the lower course of streams and slowly recedes to the neighborhood of their sources. We have no evidence of such excessive oscillation as would be needed to change the attitude of the district, and that the slope has been reversed by glacial erosion of more than 1000 feet of rock, from the neighborhood of Geneva and Auburn, is a proposition which few would care to accept.

Second:—The vast glacial filling required in the valleys south of the lakes, if they are to be held in place by morainic dams. Thus Pine Valley, the point of divide south of Havana, is 865 feet above tide. The deepest recorded sounding of Seneca Lake marks 177 feet below tide. Professor Chamberlin does not express a judgment in the matter, but quotes the commonly held opinion of an original southern flow, and then says: "If this be true, and no allowance be made, on the one hand, for drift deposits in the bottom of the lake, nor, on the other. for glacial corrasion, the total depth of the drift under the crest of the moraine must exceed 1000 feet, and this depth, approximately, must continue far down the Chemung-Susquehanna valley." *

The same is true of Cayuga, if its channel was dug by a south-flowing stream. Essentially the same is true of Owasco and Skaneateles, for although less deep, the water partings to the south are higher. Those who can, may believe that a series of valleys is blocked by 1000 feet of loose materials along the line of a moraine, which, though massive, is not massive enough to make a strong showing across the intervening ranges of hills.

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* Third Annual Report U. S. Geol. Surv., p. 355.

Third :—The lakes quite uniformly open out to greater widths northward. Cayuga Lake at Ithaca is a little over one mile wide, heading between high, strong walls. At Aurora it occupies a broad, shallow basin, and is above three miles in width. The same figures will serve for Seneca at Watkins and Dresden; while at Havana (three miles south of the lake) the width of the valley is less than a mile. Moreover, if these lakes are held in by morainic dams at the south, there ought to be signs of morainic topography in the lake bottoms and about Ithaca and Watkins, and no possible amount of post-glacial lake filling could have so thoroughly effaced it. We may, therefore, dismiss the notion of southward flow and valley-filling and seek a theory of the lakes more accordant with the topography.

Setting aside dislocations and solution, we have either buried pre-glacial channels to the north, or glacial excavation, or both, as legitimate hypotheses. Let us test them, and see first how far the theory of drift-clogged channels at the north will help us.

Take Skaneateles Lake. Its surface is 861 feet above the sea. Its greatest depth is nearly 300 feet. Its outlet runs through the village of Skaneateles and for nearly a mile northward runs practically on the surface of the boulder clay. At the Lake, the Syracuse water engineers have excavated to a depth of 20 feet, half in made soil, half in undisturbed till, with no sign of rock bottom. But between one and two miles north the outlet in its rapid descent has cut through the till into the Marcellus shale. The amount of drift barrier at the north end of Skaneateles Lake is less than 50 feet. Over 200 feet of the present depth of the lake, therefore, appear to lie in a rock basin, for there is no evidence of a buried channel. The old preglacial stream must have had about the present course.

We will apply the same test to Owasco Lake. This sheet of water is ten miles long. The city of Auburn is situated in the valley of its outlet two miles from the foot of the Lake. Here again the outlet passes over the surface of the drift for some distance, then passes gradually into a gentle sag, and one mile from the lake has made a channel 25 feet deep, with till cliffs having the usual angle of 30° or 35°. In the south part of Auburn the till cliffs are 50 to 60 feet high, and then the stream passes the railway depots and the State prison on a rock floor of jointed limestone blocks. The evidence here also is against the existence of a buried channel. I am not informed as to the depth of Owasco Lake, but whatever it be, only from 50 to 60 feet of it is due to drift blockade, and for the rest, the rock-basin theory must mainly account.

For Cayuga Lake we have no data. The altitude drops to 378 feet, or but 131 feet above Lake Ontario. The country about the north end is flat, and the outlet passes sluggishly out through the Montezuma marshes. From the general importance of the Cayuga valley and its approach to a local base level, as well as from buried channels at Syracuse and Geneva, I infer that much of the depth of Cayuga Lake—one-half or more—is due to drift barrier, not of the morainic sort, but a plastering full of the ancient channel.

For Seneca Lake we have the case more clearly before us. Hall notes* the absence of outcrop of the

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* Geology of the Fourth District, p. 164.

Corniferous limestone for several miles east and west of Geneva, and suggests that the valley of Seneca Lake once extended farther north than at present. We have also present information of a boring at Geneva, in which rock was reached at a depth of 240 feet below the surface of Seneca Lake.* If this marks the maximum depth of the old erosion, we still have 378 feet of the depth of Seneca Lake to be accounted for.

Here we have a residue of depth, plus a certain unknown but probably small thickness of bottom sediments, for which glacial excavation is the most satisfactory explanation. This is not the place to argue the digging power of glaciers. I do not urge it upon any who, like a recent rather severe critic of the United States Geological Survey, are ready to confess that the glacial period "is a fiction." Nor do I ask for a glacial erosion adequate to scoop out such basins as those of Ontario or Michigan, which, however, I do not deny. Rather do we seem driven to postulate ice work sufficient to change a well-deepened stream valley into a basin whose depth is, after all, very slight when we consider its superficial extent. Sceptics are apt to be merry at the expense of believers in rock basins by ice; they are "great believers in soft places," etc. How can ice scoop debris out of a pit hundreds of feet deep, they say. Such objection arises largely from that exaggeration of the vertical scale which we are so slow to outgrow, in delineating elevations and depressions, as mountains and sea bottoms. I give an illustration in the following diagrams. Fig. 1, drawn in the same proportion as the longitudinal section of Seneca Lake upon the Cornell University Engineering Department map,* would give the lake a depth of between three and four miles. Fig. 2 is still so much exaggerated in vertical scale as to give the lake a depth of 3000 feet. A section could be drawn true to scale by swelling slightly the under side of a straight line. Fig. 3 is a cross section of Seneca Lake in its deepest part, as shown upon the Cornell map, while Fig. 4 gives the actual cross-section. It will be seen, therefore, that we do not require the ice to rise out of a steep-walled pit, with its load of debris, but that the amount of scoop is relatively very slight.

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*Glaciation in the Finger Lake Region of New York, by D. F. Lincoln, Am. Jour. Sci., Oct., 1892, p. 301.

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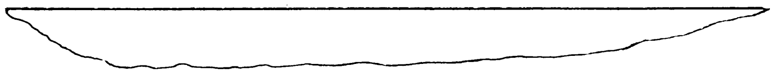

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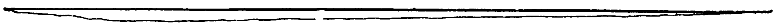

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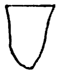

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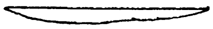

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* A method which engineers find it needful to use, but which geologists and geographers should discard when possible.

If it still seems too much to ask an erosion of 200 to 300 feet, it is possible that a further consideration may have some bearing, viz., crust oscillation. Recovery from northern depression would have some tendency to deepen the basins, especially toward their southern ends, which is precisely where our demand for cause is the heaviest. Professor Shaler has suggested that such a movement may have developed the marsh lands already spoken of as extending from the foot of Cayuga Lake.*

I propose now to inquire whether the outline of history given is accordant with certain further facts, and whether in any measure it answers the queries already set forth. To review briefly, we suppose the basins to be a composite resultant of valley erosion, glacial scoop and drift barriers, with perhaps a slight element of orography.

One of the problems presented is the deepening of the lakes southward. As above indicated, I cannot consider this as due to pre-glacial southward flow. Narrowing of the ice between contracting valley walls increased the vertical pressure and hence intensified the erosion. For this law of glacial action we have so good an authority as Geikie.† Again, the deepest part of the lakes is not far behind the terminal moraine, and was therefore for a long time the seat of severe ice action. On this phase of the case I find the following summary of the view of Böhm on "Die Hochseen der Ostalpen." ‡ "The Alpine lakes are divided into two groups, the valley and the mountain lakes. The former are in general large and occupy the valley on the circumference of the former glacial region, where the ice streams at the time of maximum glaciation could exert their greatest force." This is precisely the attitude of the Finger Lakes in relation to the moraine. It may be noted that Otsego and Schuyler are likewise north of a somewhat morainic belt. Added to the above considerations is the fact of southward dip of the beds out of which the basins have been dug, and the further fact that the beds (Marcellus and Hamilton) are relatively soft, as compared with the limestone below, and the massive sandstones above and southward. The deepest lakes were made by the heaviest and most persistent ice streams of the larger valleys. It must be said here, however, that we are not prepared to answer the query, why lakes in some valleys and not in others, as for example the Genesee, which marks a deep preglacial furrow, and whose valley must have been the scene of vigorous glaciation. The relation to the moraine determined in part the east and west arrangement of the series. It seems to have been further determined at the north by the resistant horizon of the Helderberg, upper and lower, which the ice could not breach, except as pre-glacial rivers had sawed it in two, as at Cayuga and Geneva. The high, massive upper Devonian sandstones probably also in some measure combined with the limit of glaciation in determining the southward extension of the lakes. The preponderant number of lakes in Western over Eastern New York may be accounted for by the existence of the Ontario depression, the consequent heavier ice flow, than across the Adirondacks and the Mohawk valley,* and the existence of a wide northern slope between the Ontario sag and the Ontario-Chemung watershed.

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*Tenth Annual Report, U. S. Geol. Surv., p. 266.

† See "Scenery of Scotland," p. 232.

‡ Am. Jour. Sci., 3d Series, vol. xxxiii., p. 431.

Does the topography accord with our medium estimate of the amount of glacial work? The view held is that the topography has been modified but not revolutionized by ice, that the northern slope, the valleys and ridges were pre-glacial, and that valleys were deepened, ridges rounded, and some transverse valleys filled by ice. If corrasion was not excessive, pre-glacial tributary valleys should, in cases, appear. The depression from Penn Yan to Dresden is such a pre-glacial tributary to the Seneca valley, moderately mantled with till, through which and into the underlying rocks the outlet of Keuka Lake has cut in moderate degree. Most of the larger pre-glacial tributaries may also be supposed to have entered to the northward, where the country was well progressed toward base-level, and whose lower courses may now be concealed by drift.

The questions relating to the post-glacial history are more easily answered. As with other recent history, there has been less time for the complication of causes and results, and the features in question stand out sharp and unmistakable.

The recency of the outlets is marked. As already described, the outlets of Skaneateles and Owasco have not yet had time to cut back through two miles of till with a thickness of 50 feet. They flow out over the surface of the drift as if they had started but yesterday. The same is true of the outlet of Seneca, above Seneca Falls, while at Penn Yan it is very plain that the water has backed up through the shallow eastern arm of Keuka Lake and found its way over the drift into an old valley running eastward.

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* Note the following law, stated by Prof. R. D. Salisbury, Geol. Surv. of N. J., An. Rep., 1891, p. 58: "The depth of moving ice is one of the determinants of its velocity, and because of the greater depths of ice in valleys its motion here was most rapid, and its abrading action powerful."

Hundreds of ravines mark courses of small streams entering the lakes, efforts to perfect a new system of drainage for the intervening regions. In some cases fifteen or twenty to the mile can be counted along the steeper borders of the lakes. Watkins' Glen is the best known of these post-glacial cañons, although it enters upon the main valley a short distance above the head of Seneca Lake, but not, however, above the original extension of the lacustrine area. Three miles to the south on the same or west side is Havana Glen. Upon the borders of Seneca Lake some miles from its head are Glen Ora and Hector Falls. Numerous glens with falls enter upon Cayuga Lake, as Eagle Cliff Falls by the campus of Cornell University, and Taghannock, the highest waterfall in New York, a few miles to the north of Ithaca. Largely post-glacial also are the cliffs of rock seen so extensively on the lake shores, and forming, especially on the east shore of Cayuga Lake, one of the finest natural geological sections in the world.

The remaining changes may be placed under the head of lake filling. No perceptible change has been made in the area of the lakes by cutting down of outlets, for, as has been seen, such cutting has not yet reached up to the lakes themselves. In this they agree with a recent statement regarding the lakes of the

Adirondack wilderness.* The Finger Lakes, however, do not agree with the Adirondack lakes in rapid development into vlies or natural meadows. The only approach to an exception is at the head of several lakes, as the level tract on which Ithaca and Watkins are built. These areas must be due to filling, and doubtless result from the silting up of the always shallow southern ends, by materials brought not only from the hills directly above them, but also by debris contributed from all the side ravines as far south as the divide, these materials being brought down by the inlets and building the land area farther and farther to the north.

Along the margin of the lakes are many points, in area from a fraction of an acre up to several acres. They are, of course, delta deposits made by lateral streams, in some cases assuming the form of true alluvial cones. They are utilized as steamboat landings and sites for villas, and add to the beauty of the lakes, but are not as great in extent as one would expect. Why there should be less filling than in the Adirondacks it is hard to see, especially as the soil is largely bare of forests and exposed by agriculture. The cones do not appear to affect the soundings to any distance, which is doubtless due to the fact that the transporting streams are torrents which discharge little solid matter except in the spring, and then of such large fragments that they come to repose near the shore.

The bottom filling I regard as small in amount. The soundings fairly show that there is little or no morainic accumulation at the bottom, and we probably have a moderate depth of fine silt mantling the rock contours of the several depressions. At a distance of 500 feet from the foot of Skaneateles Lake, the Syracuse water engineers have found 6 to 8 feet of fine, smooth lacustrine clay. As they progress with dredging toward shore they will pass into the underlying rock or till, and the depth of lacustrine filling at that point will become evident.

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* See an interesting account of "Lake Filling in the Adirondack Region," by Prof. C. H. Smyth, Jr., American Geologist, February, 1893.

Still, on the whole, the amount of filling in the Finger Lake region cannot be considered unimportant or the rate a slow one, for the geologist is, of right, lavish of time. In his mode of reckoning, therefore, lakes are evanescent products of world-making energies. They were born yesterday and will perish to-morrow, but not without filling their place in the economy of nature and adding, in varied ways, their contribution to the resources of man.